Social cost of electricity generation in non-EU countries

Zhu, Xianli

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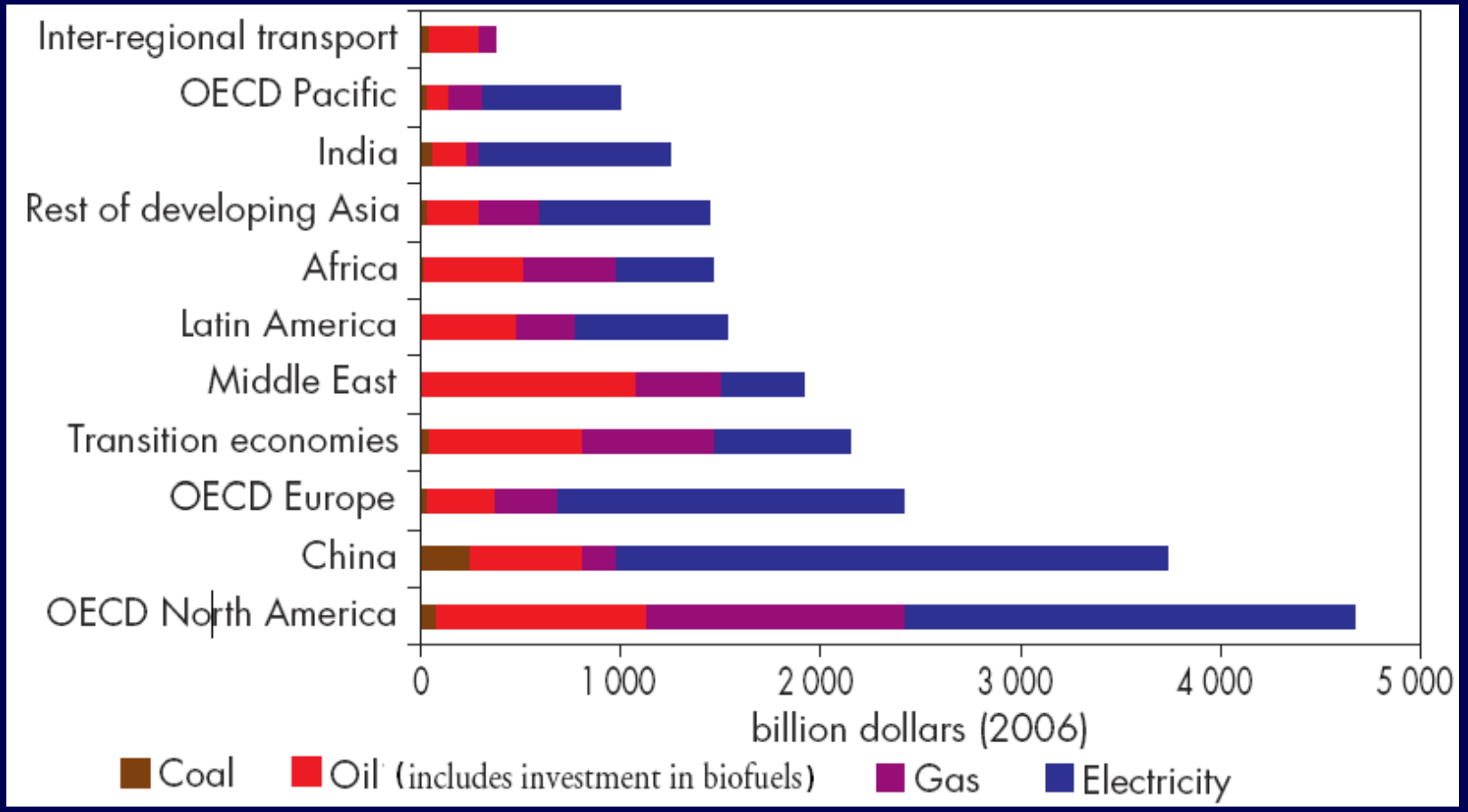
Social Cost of Electricity Generation in Non-EU Countries

Dr. Xianli Zhu

UNEP Risø Centre

Risø-DTU

Cumulative Investment in Energy Infrastructure in the Reference Scenario by Fuel and Region, 2006-2030



- The external costs, if not properly integrated in energy investment policy and decision-making, will have enormous impacts on the global environment

About WP7

Target: conduct life-cycle external cost analysis of different fuels in 5 non-EU countries, currently and till 2030, each country two fuel cycles.

The 6 Research Institutions Participating in WP7

Research Institutions	Short Name	Country
National Laboratory for Sustainable Energy	RISØ DTU	Denmark
Fundação COPPETEC	COPPETEC	Brazil
Indian Institute of Management Ahmedabad	IIMA	India
Energy Research Institute	ERI	China
Turkiye Bilimsel ve Teknik Arastirma Kurumu – Marmara Research Center. Institute of Energy	TUBITAK	Turkey

Work under WP7

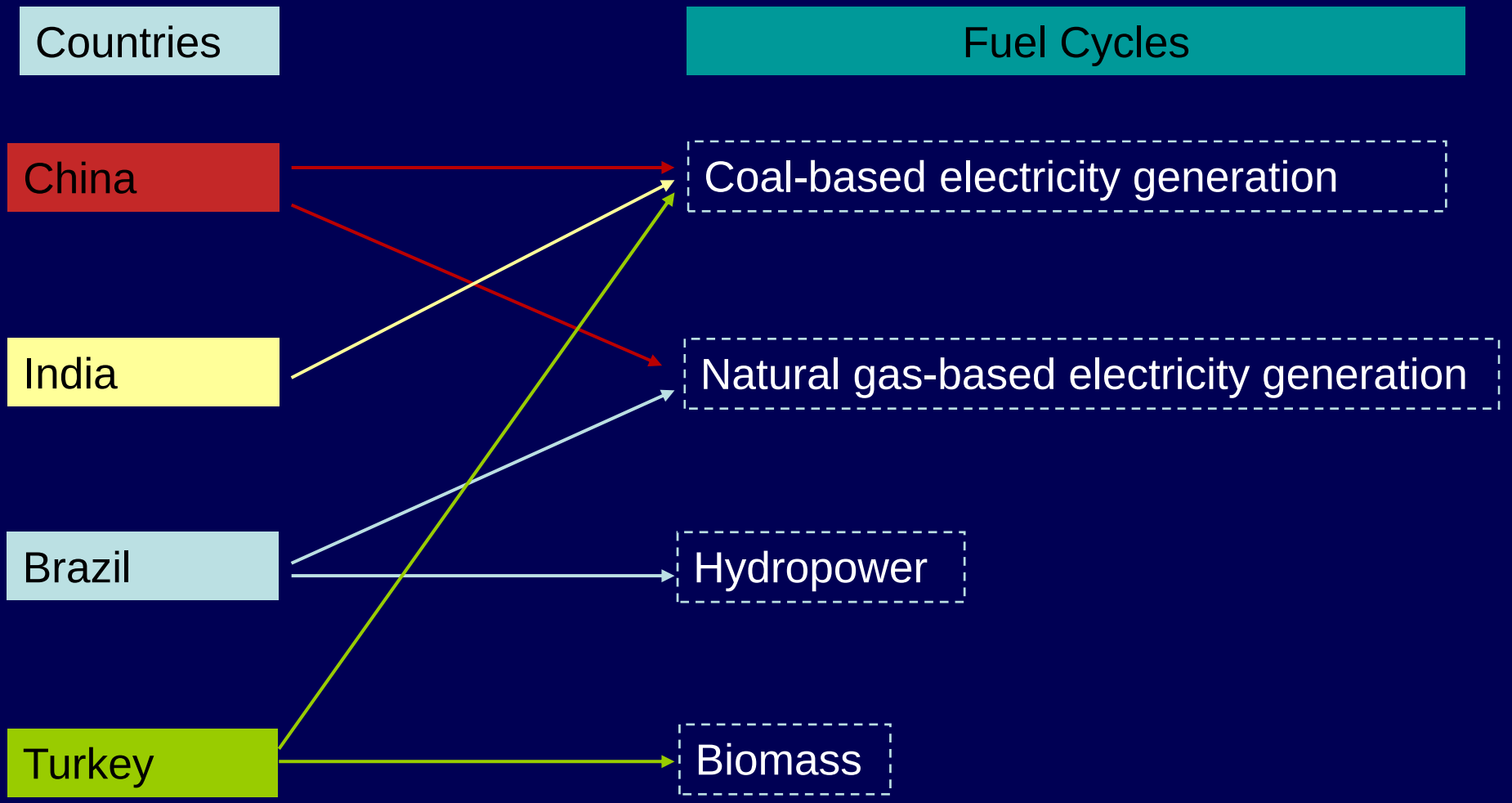
Output of WP7

- Methodology report by Risoe in May 2007
- 6 reports of the country studies (China's coal and natural gas fuel cycles are in two separate reports) in late 2007
- A cross-country comparison report finished in Jan 2008

Differences from the studies in EU-countries

- First Non-EU component under ExternE
- Small budget for this part, based existing studies
- Methodology simplified

Research carried out under WP7



Comparison of the case studies by the different countries

Results of the Country Studies

- The country studies uses different currencies
- Different assumptions about external costs

Adjustments to improve comparability

- Currencies converted to Euros
- Standard NEED marginal damage costs have been applied

GHG	CO_2	CH_4	N_2O	SF_6
Marginal Damage Cost (2005 €/ton)	20.66	747.29	27202.90	1290.64

Results of the case studies (€ cent/kWh)

Fuel cycle	Brazil	China	India	Turkey
Coal		2.54	5.98	
Lignite				3.35
Natural gas	1.20	0.92		
Biodiesel				Unquantif.
Hydro dam	0 / 0.043 / 0.129			

Estimated external costs of coal fuel cycles

Fuel cycle	China € cent/kWh	India € cent/kWh	Turkey € cent/kWh
Coal	2.54	5.98	
Lignite			3.35

CO_2 price choice has major impact on total external costs:

	CO_2 emissions (g/kWh)	Adjusted CO_2 emission costs (€ cent/kWh)	% in total external cost	Total external cost (€ cent/kWh)
China	816.64	1.69	67%	2.54
India	1368.66	2.826	47%	5.976
Turkey	1031.53	2.132	64%	3.35

In China, tariff to coal-based power generation around 2.3 € cent/kWh, that of wind power, around 5 € cent/kWh, in a way the external costs is reflected in the tariff difference

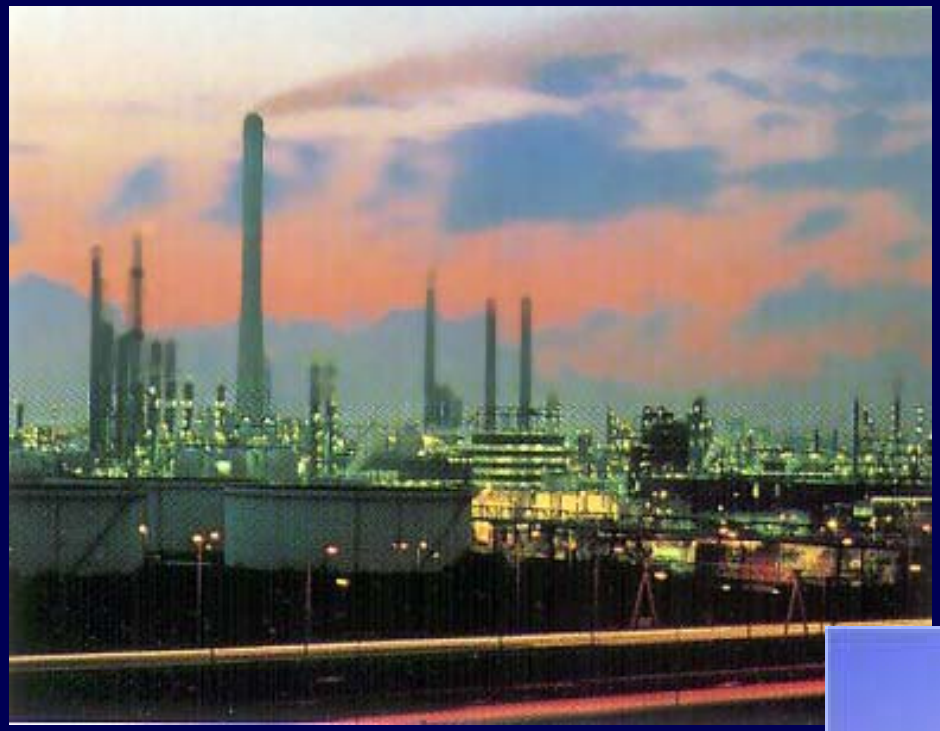
Coal fuel cycles – external costs quantified and valuation

		Stage	Impacts quantified	Unit Price
China	**Coal**	Coal combustion	SO_2, NO_x, CO, CO_2,, SP, Powdered Coal ash, Furnace Dust	China national standards on emission charges
India	**Coal**	Mining	CO_2, CH_4, RPM, SPM, SO_2 NO_x, Water*	SO_2 and NO_x: prices from the US market RPM and SPM: an Indian study of human health impacts GHG emissions: EU ETS price Water: water price for industrial consumers in India.
		Beneficiation	CO_2, SO_2, NO_x, Water*	
		Transport	CO_2, SO_2, NO_x	
		Power generation	CO_2, SPM, SO_2, NO_x, Water*	
		Ash disposal	CO_2, CH_4, SPM, SO_2, NO_x,	
Turkey	**Lignite**	Coal transport and Power generation	CO_2, SO_2, SO_2, TPS, liquid waste, solid waste	Results given in physical terms

External costs from coal combustion differ

		CO_2	SPM	SO_2	NO_x	Water	CO	Ash	Dust	Total cost
Emissions (g/kWh	China	816.64	0.189	8.416	3.792	-	0.122	51.95	14.21	-
	India	1307.7	0.280	7.48	4.09	0.725	-	-	-	
	Turkey	999.3	0.22	6.08	2.25	-		-	-	
Unit costs (€ cents/kg)	China	2.066	20.5	55.8	74.4	-	0.214	1.116	0.93	-
	India	2.066	7071	44.12	117.4	0.862	-	-	-	
	Turkey	2.066	359.09	156.7	80.89	-	-	-	-	
External Costs (€ cents/kWh	China	1.69	0.004	0.47	0.309	0.001	0.001	0.058	0.013	2.54
	India	2.70	1.98	0.33	0.48	0		-	-	5.49
	Turkey	2.065	1.079	0.953	0.182	-	-	-	-	3.279

- The differences are not because of various price assumptions than different emission levels



Natural gas fuel cycles

Country	Brazil	China
Stages	Gas extraction and power generation	Power generation
Emissions	CO_2, CH_4 and N_2O	SO_2, CO_2, NO_x, Suspended particles
Valuation	Increase in the incidence of respiratory diseases	China national standards on emission charges and US standard
Results	**1.20**	**0.92**

- The Brazil study quantified the external health costs during natural gas extraction and use for power generation
- The China case study focus on charges to be paid for emissions from natural gas based power generation

Brazil hydropower fuel cycle external costs

Mortality and morbidity cost

Statistical Value of Life: Calculated based on the EU statistical value of life for 1998 ($3,250,000.00, in 1992 $), per capita GDP, the parity of purchasing power, life expectancy, as well as health expenditures. US$ 929,743.75

Disease cost Total = expenditure on treatment + value of work days lost

Increase in water-borne disease (avoided costs) = Avoided costs of leishmaniasis + avoided costs of dengue fever + avoided cost of malaria

Results of the Brazil Hydropower Health Impact Case Study

Construction & power generation	Unit	Local health system	Vector born diseases	Total cost
Rio Madeira	€ cent/kWh	0.070	0.059	0.129
Tucurui	€ cent/kWh	-	0.043	0.043

Conclusions

- The existing studies mainly focus on emissions (GHGs, SO_2, NO_x, PM) or resource consumption (water, land) during fuel combustion
- The valuation is mainly based on emission charges set by the government, or shadow prices
- The ExternE damage function approach can only be applied based on detailed local context
- The external costs of GHG emissions, if valued based on EU ETS price, contribute to a high proportion of the total external cost of fossil fuel cycles
- The estimated results of different fuel cycles are generally in a reasonable range
- For more complete understanding, further study needs to be done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